This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

48. 1862.

THE

NATURAL HISTORY & HABITS

OF THE

SALMON,

FROM A

LONG SERIES OF EXPERIMENTS AND OBSERVATIONS.

BY

ANDREW YOUNG,

MANAGER OF THE DUKE OF SUTHERLAND'S SALMON FISHINGS, INVERSHIN, SUTHERLANDSHIRE.

WICK:

PUBLISHED BY PETER REID.

LONDON: W. S. ORR AND CO. EDINBURGH: OLIVER AND BOYD. GLASGOW: F. ORR AND SONS. PERTH: DEWAR AND SON. ABERDEEN: LEWIS SMITH. AND SOLD BY ALL BOOKSELLERS.

MDCCCXLVIII.

WICK:

PRINTED AT THE JOHN O'GROAT JOURNAL OFFICE.

TO

ROBERT WALLACE, ESQ. OF KELLY,

FORMERLY M.P. FOR GREENOCK,

ONE OF SCOTLAND'S TRUE REFORMERS,

AND

MOST SINCERE FRIENDS,

WHO FOR MANY YEARS SERVED HIS COUNTRY HONESTLY IN PARLIAMENT,

THE FOLLOWING PAGES

ARE RESPECTFULLY INSCRIBED,

BY

HIS SINCERE AND FAITHFUL SERVANT,

THE AUTHOR.

Preface.

We have, throughout all our experiments and observations, on the Habits of the Salmon race, kept a strict eye to the public good, as well as to the improvement of private property; and determined that, if any information or change of opinions should be the result of these observations, at some time or other we would give them to the public; and being of late very much pressed to do so, we now humbly submit them for general use,—particularly dedicating them to those who take an interest in the welfare of the Salmon; and earnestly hope that this short Treatise will amuse as well as inform the Reader.

Invershin, May, 1848.

THE NATURAL HISTORY OF THE SALMON, &c.

THIS subject has long puzzled the brains of the greatest naturalists. Any rational looking theory that was introduced by one, was very soon supplanted by that of another, and thus the subject went on for many centuries, with opposing, and still changing opinions, the world meanwhile remaining in complete ignorance of the true history and habits of the salmon. Need we wonder at the ignorance of the more illiterate, when we find, in modern times, such men as Sir William Jardine, Sir Thomas Dick Lauder, Mr James Wilson, &c., unable to trace out, or throw much additional light on the subject? No. They had travelled, examined, and dissected, and yet, with all their intense anxiety to enlighten mankind, and to pry into the secrets of the deep, they had almost begun to rest satisfied with the old traditionary supposition, viz.—that the ovum spawned during the spawning season became the grilses of the following summer. Yet, notwithstanding the total failure of these individual researches, the world is much indebted to them for what they have done, as they fostered the spirit of enquiry, and encouraged others to persevere and go ahead. By these observers the fish were seen spawning, the smolts were seen descending in their proper season, and the grilses returning with the same punctuality they still continue to do. But yet the actual facts of their progress,—from the ovum to the smolt, from the smolt to the grilse, and from the grilse to the salmon,—were uncertain with

all of them; and they could show nothing farther than what tradition and fictitious imagination had handed down from one generation to another.

In this dark and uncertain state, matters continued until within the course of the last twenty years, when a spirit of experimenting becoming the age entered into many, and no exertion was spared which could in the least throw light on the subject. Among those who deserve a conspicuous place as enlightened investigators, we may mention Mr John Shaw, of Drumlanrig, who has largely added to supply the deficient links in the history of the salmon —particularly in that part between the ovum and the smolt— which he carried through with accuracy and care. But as his experiments are already fully before the public, they require no farther comment here. Another valuable experimenter has been lost to the country, by the death of Sir Francis A. Mackenzie of Gairloch. He left us in the midst of our labours, and his loss was a strong spoke from the wheel. Where is his successor? But now the spirit of experimenting has begun, and it must, under all unfavourable circumstances, be persevered in. The public thirsted for the knowledge that could only be procured from the bosom of the deep and its tributaries, and through these dark regions the history of the salmon must now be traced.

To arrive at the full knowledge of facts, salmon have been caught by us in different rivers, have been marked with particular and various marks, have been traced to the sea, and back to these several rivers, and that process was continued throughout all their different migrations at their different ages; and in all these experiments we have succeeded to our utmost satisfaction, and never found them, in one instance, varying from the perfect rules of nature. The salmon fry have been hatched from the ovum in artificial

ponds, carefully constructed for the purpose, and in these ponds the fry have been reared until they arrived at the smolt state,—that is, the age at which the young salmon undertake their first migration to the sea, known in fisher's phrase as "the smolts going down." During their sojourn in the artificial ponds, they were frequently and carefully compared with their co-ages that were hatched and rearing in the open river, and on all occasions they were found exactly to agree, both in size and appearance. Specimens, at different ages and sizes, have been taken from the ponds and preserved, which show the actual growth from one month to another, and, by placing them side by side, we see at a glance the growth of the fry from the ovum to the smolt, and by this means the former conclusions, or old theory, on the habits of the salmon, have been entirely changed. The former supposition was, that the spawn deposited in the course of one spawning season produced the grilses of the following summer, or fishing season,—later experiments proved the fact, that the fry of the salmon are ONE WHOLE YEAR in the fresh water, from the time they are hatched from the ovum, before they arrive at the smolt state, viz.—when they are prepared with the silvery coating, and fitted for their first migration to the sea. This being a new doctrine, although an undoubted truth, some who were perfectly satisfied with the old imaginary theory, and who had written volumes on the history of the salmon, in which that theory was copiously introduced, were something stiff in giving it a place among their formerly collected and published ideas, and this not so much from doubting the truth of the facts, as from its entirely changing what they had previously written, and which, up to this time, was unquestioned; but now their theory, having entirely lost its foundation, must be considered Apocryphal,

and, in the estimation of public opinion, must go for nothing. But from often repeated experiments, all producing the same facts, few are now found who doubt the truth, and these few are not over scientific; although they consider themselves in duty bound to seem to believe the tales of their grandfathers, never doubting but that they were born with a perfect knowledge of all the works of creation. However, in the meantime, we will leave such to glory in their hereditary opinions, and here state that, from repeated experiments, the habits of the salmon are as well known to us as the habits of any domestic animal. We can now arrive to a fraction at what will be its progress from one year to another; and, by observing the favourable and unfavourable breeding seasons, as well as the state of the rivers, we can easily estimate, and that to a certainty, what the next fishing season will produce.

A plentiful spawning time will never produce a numerous fishing season, unless it be accompanied by other favourable circumstances. We may have abundance of breeding fish, and yet the rivers, during the most part of the spawning season, be not in the proper state to receive the seed to advantage. The rivers may be too much flooded, and by that means the fish are forced to spawn too near the land sides, and as soon as the rivers fall off, and get into a low state, many of the spawning beds are found on dry land, the spawn of which must be lost. On the other hand, the rivers may be too low, or frozen, and so prevent the fish, in a great degree, from performing their spawning operations, and thereby much of the seed is lost; for it is a well known fact, that, although salmon, at a certain period, when the seed is ripe, have the power of spawning, yet beyond a certain period they have not the power of retaining it; and when prevented from spawning at the time, when the spawning organs and seed

are prepared for that purpose, the greater part of that seed is lost. All these things must be observed with care, before we can speak with certainty of their future state. Many will say, from seeing numbers of fish in the river in November, that such a season will be followed by a good fishing season, as the river is well stocked with breeders; but this is a very uncertain calculation, for we may see abundance of breeders, especially late breeders, whose produce will add but little to the common stock. But let us spare, and allow a good stock of early breeders, and all chances will be in favour of a fruitful spawning season. On the success of the spawning alone depends the future prospects of our fishing seasons.

The most illiterate fisherman is aware, either by observation or by hearsay, that salmon spawn during the early winter months, and that their operations take place partially or altogether in fresh-water rivers. Indeed, many of our forefathers had over-extended views on this subject, and willingly conceded to the spawning fields all fresh-water lakes having communication with rivers, as well as the shores of the sea coast, in addition to fresh-water streams. But these statements were only imaginary, and spoken entirely from supposition; for experiments on these different opinions have completely obliterated all doubts and uncertain ideas, and have thoroughly convinced us that salmon can nowhere spawn to advantage but in rivers and streams, and in these only where the rivers run at a certain velocity. Repeated experiments have been tried to arrive at these facts. We have deposited the ovum of the same fish, part in a stream and part in still water; we have watched both parts carefully, and examined them frequently, but we never yet found a grain of what was deposited in the still water productive, while the other part that was deposited in the running

water all produced fry in due time. We have frequently repeated the same experiment,—each time with the same effect; therefore we must conclude that salmon neither spawn in lakes, nor on the sea coast, and that nowhere can the spawn be productive but in running streams.

The spawning season extends over Six Months in the year at least. It may be more, however, for we have seen them spawning at all the intermediate periods,—from the middle of September to the middle of March; we have also seen fish full of spawn after the latter period, and believe they did spawn after that, although we did not see them in the actual operation. But when we consider the times at which the recognised spawning season begins and ends, we must conclude with certainty that the present "Fishing Laws" are extremely hurtful to early spawning,—that they have nearly destroyed that part of the fish once known as early, or Spring, salmon, and thereby ruined the Spring Fishing over Scotland. It is a pity that such should be the case, when it is so well known that the early breeders and the Spring salmon are the most valuable parts of the stock; and I am sorry to see the greater part of fishers, now-a-days, look more to a small and almost useless "bird in the hand" than to two large and valuable "birds in the bush,"—but times must change,—the laws must be altered,—the spirit of destruction must give place to a spirit of improvement. This must become the general rule: we should look much more to the future, and those unwilling to do this must be compelled by force of law to do so.

What stock can be pointed out, with the exception of salmon, of which the worst and uncertain part only is kept for breeders? We say, none whatever. Salmon are the only exception to the general rule; they are killed long in the season after they are

almost useless, and only a tithe of them are fit to be shown in a public market at the time the destruction, under the present bad laws, ceases, and even that same tithe are unprofitable,—none being left to propagate the race, but a few of the weakest and most useless part of the stock—a part found useless to kill, and, we must say, nearly as useless to leave alive; as they, from the lateness of the season, have to encounter both the floods and frosts of winter, either of which are certain to render them next to useless.

The September spawning generally begins with a few pairs, chiefly grilses;—I allude to rivers that are allowed to have September spawning; for rivers that are fished up to the 14th of September, and the breeders all killed up to that date, can have no September spawning. The grilses are in general preceded by the sea trout, and when we see them approach the spawning fords, we, in fisher's phrase, say, the grilses will soon begin to spawn, as the trouts are there already. When the grilses are seen on the spawning fords, they are soon accompanied by a few salmon, and both salmon and grilses increase in number up to the first of December. From the middle of November to the middle of December may be considered the principal throng time of the spawning season. The fish always begin to spawn at the tops, or farthest up parts of rivers; but, by the middle of November, the spawning is general over the river, from top to bottom, and we cannot see a suitable stream or ford, from top to bottom of the river, but what is occupied by its pairs or dozens of pairs, according as the space will permit. Here all is regularity and order; but on rivers where the throng of the spawning of a few uncertain fish is forced back to the middle of December or of January, by fishing one month too late in the season, the case is deplorable; for one day we see a full appearance of spawning, and to-morrow both the spawn and

spawners are scattered over the river by the force of a winter flood,—scattered as a prey to the elements, and the enemies who eagerly watch their spawning operations.

From December to the middle of March, the numbers on the spawning beds decrease in about the same proportion as they increase from the middle of September to the first of December,—the spawning near the tops of rivers being finished, while numbers of fish are still seen on the fords farther down, and near the bottom of the river. On these fords where the spawning begins late in the season, we invariably see the fish spawning at the latest period of the season, and when none are to be seen spawning at the top and upper parts of the river, we still see the operations going on farther down; and although these operations continue long after the fishing season begins, the one department never interferes with the other, as the fishing stations are invariably in still, deep water, altogether completely separated from the fords and spawning grounds, and no skilled fisher ever attempts to drag a net over these shallows. Salmon are watched on their progress up some rivers, and, when they are seen ascending, are fished for in the first deep pool above the fords,—the net, however, never in any case coming in contact with the shallow water, so that spawning fish could not in the least be disturbed, although they were performing their operations during the fishing season, and few fishers, with the exception of the very poor and ignorant, will disturb the spawning beds during these operations, at any season of the year.

Some "wise men" still actually believe, that fishers fish for and catch salmon on ford-heads and shallows. Among others, we may mention the Magistrates and Town Council of Dundee, who met in 1846 to pass resolutions against the present mode of fishing, and in favour of catching salmon with barriers of fixed machinery. We

shall here give their own words:—"For example, the existing laws permit the dragging of nets in rivers over the places where the spawn is deposited, and where the young fry haunt, destroying myriads. But they forbid the use of fixed nets in estuaries, where there are no spawning places, and none of the fry." We must here agree with the electors, and, at all events, think that the Town Council of Dundee, like other Town Councils, is a wise body of men,—they being particularly chosen from among the wisdom of the town, and considered to have superior knowledge in town and country matters. But we are very doubtful regarding the Dundee Town Council's knowledge in salmon fishing; for who ever yet heard of fishers dragging their nets over fords and shallows where the spawn is deposited, in search of salmon? None ever did so; for they know well that salmon never haunt these shallows but for the purpose of spawning; and as soon as these operations are over, they remain there no longer, but fall back to the first deep pool below the ford,—continue to fall back from one deep pool to another, until they reach the estuary, and from that to the sea; but they are never seen resting in shallows and on ford-heads after their spawn is deposited.

The Magistrates and Town Council of Dundee also say that none of the fry are in the estuaries. We cannot see how this can happen, as the fry have no other channel whatever by which they can proceed to the sea but through the estuary. But perhaps it is not generally known to them, that the fry of salmon require to go to the sea before they can arrive at maturity; at all events, we must conclude this to be the case with the Town Council of Dundee, and, at the same time tell them, that stake-nets in estuaries have undoubtedly been the most destructive engines to the salmon fry that have ever yet been invented, or that ever can be invented; and

where the stake-nets were in full force, and in the hands of other Town Councils, cart loads of the fry of salmon and other fish have been destroyed by them. Indeed, we may partly date the decline of salmon fishing from the first erection of these murderous and unlawful instruments; and wherever they have been persevered in they have reduced the fishings to the lowest ebb, and will continue to do so, until salmon will only be spoken of as things that were.

The works of Creation are beautifully displayed in the breeding of fishes,—Nature having directed the male and female to approach the spawning-bed at the same and proper season. They unite in selecting the spot in the stream—they unite in excavating the gravel from that spot, so as to make a bed for the depositing of the seed; and as soon as they have dug it to a sufficient depth, varying in different spawning-beds, from nine to eighteen inches, the female deposits part of the ova, which the male immediately impregnates with the milt. A careful observer can see both the ova and the milt falling into the spawning-bed, where they rest among the gravel in the bottom of the bed. They are then covered over by the fish—still continuing to work up against the stream—thus extending their bed, and, at the same time, covering the already deposited seed with the gravel digged out of the extended bed. This process is followed until all the seed of the pair is deposited,—still digging, spawning, and covering. No previous intercourse is required between the sexes,—they having no connection whatever until they arrive at the spawning-bed. Mr Tod Stoddart, a gentleman who has written largely, and, to appearance, fabulously, on the habits of salmon and other fish, tells us that it is not unfrequent to see a female salmon performing the spawning functions in absence of a male; but such a statement

must proceed from incorrect observation, or, perhaps, from the want of spectacles, as such a thing is impossible, for nature has formed these fish with a perfect uniform habit. Although we should see a hundred pair spawning at once, they are all distinctly in pairs, and we can discover no "old maids" among them, trying to propagate alone. Every female has its male, and among the whole there is no Polygamy, although second marriages among them seem to be the order of the day. We once knew a notorious salmon poacher, who, on one of his excursions, saw a pair of salmon spawning in a stream. He leistered the male from the side of the female, and as soon as she missed her partner, she retired from the spawning-bed into the pool below the ford, and very soon returned with another male, which the poacher also leistered. In the same manner, the female continued selecting males, the poacher as often killing them, until he killed nine male fish from the side of the same female; and, last of all, she returned from the pool with a common river trout, when the poacher killed the female also. Mr Tod Stoddart tells us also of seeing 50 females spawning in a pool on the Blackwater near Contin, in Ross-shire, and but three male fish among the whole. But his description of spawning is so unlike anything of the kind we ever saw or ever heard of before, that it is really not worth following him through the meshes of his impossibilities; and we would just say, it would have been better for both the public and himself, had he buried his vagaries in one of the caverns on the banks of the Tweed, where they were collected.

We have often experimented on the ovum of fishes, merely to arrive at facts. We have impregnated a part of the ovum of one fish with milt, and have left part unimpregnated, and then deposited both parts in the same stream, at the same depth, and in a current of exactly the same velocity; but never in any one instance did we

find one grain of the unimpregnated part productive, while the other portion that was impregnated with the milt never failed to produce fry in due time. This has been frequently tried, and has at all times proved the same.

The ova, after being deposited, progress very slowly, particularly during the winter season, when the temperature of the water is low; as the length of time between deposition and hatching depends entirely on the heat or cold when the seed is lying among the gravel. Ova deposited in September, when the temperature is high, will produce fry in the course of 90 days, while those deposited in November and December, will require something between 100 and 140 days, according as the winter months may be favourable or unfavourable. Until of late years, it was never imagined that seed spawned in September and October were hatched, and the fry at large in the rivers, in the following December and January. No. Our forefathers believed that both early and late spawn lay snug in the egg until the following spring, and then appeared at or near the same time, and in the course of a few days afterwards proceeded to the sea as smolts. This was the settled opinion of Naturalists and others, who have studied and written volumes on the habits of the salmon, and, among others, that celebrated Naturalist and dissector, Dr. Knox, who watched the spawning beds until he thought he had arrived at their habits and natural history. On stating his observations on salmon spawning in the Tweed, he says—"On the 2nd of November, a pair of fish were watched, and the ova were observed to be deposited near the source of the river, and covered up in the usual way; and on the 25th of February, or 113 days after being deposited, the ova on being dug up were found unchanged; but three days later, or 116 days deposited, he says a very careless

observer could have seen the young fish turning over within the shell of the egg—(what a sudden change in three days!); but on the 23rd of March, the ova are now changing, the outer shell is cast, and the fry are lying embedded in the gravel, as fishes somewhat less than an inch in length,—being now twenty weeks from the period of their deposition." On the 22nd of April, when they were one month old, the all-wise Doctor says he was ca.ching them with the fly as smolts, the size of his little finger.

We are not to doubt the Doctor's ability as an observer, neither do we think that he intended in the least to mislead the public, although, in the first place, he says the ova were much changed at 113 days; and, in the second place, he was catching the smolts one year old, believing them to be the fry of one month old. How could he be blamed for believing so? as at that time every one believed in the rapid growth from the egg to the smolt, as well as he, and no man then imagined that young salmon under the size of smolts existed in the rivers. All fishers, and those who observed the habits of fish, were aware that during the summer months the rivers swarmed with small fish, from one inch to three inches long, but what these fishes were none could form a satisfactory opinion; for if any one ventured to suppose that they might be the young of the salmon, he was soon told by others that no young salmon could be seen in the rivers later than the month of May, and confirmed it by repeating some old rhyme, such as—

"The first flood in May
Carries all the smolts away."

We are all aware that, in old times, old rhymes were much more relied on than new facts, and the old faith continued among fishers up to the time that repeated experiments convinced us that our belief was wrong; that in place of the fry that are hatched in

find one grain of the unimpregnated part productive, while the other portion that was impregnated with the milt never failed to produce fry in due time. This has been frequently tried, and has at all times proved the same.

The ova, after being deposited, progress very slowly, particularly during the winter season, when the temperature of the water is low; as the length of time between deposition and hatching depends entirely on the heat or cold when the seed is lying among the gravel. Ova deposited in September, when the temperature is high, will produce fry in the course of 90 days, while those deposited in November and December, will require something between 100 and 140 days, according as the winter months may be favourable or unfavourable. Until of late years, it was never imagined that seed spawned in September and October were hatched, and the fry at large in the rivers, in the following December and January. No. Our forefathers believed that both early and late spawn lay snug in the egg until the following spring, and then appeared at or near the same time, and in the course of a few days afterwards proceeded to the sea as smolts. This was the settled opinion of Naturalists and others, who have studied and written volumes on the habits of the salmon, and, among others, that celebrated Naturalist and dissector, Dr. Knox, who watched the spawning beds until he thought he had arrived at their habits and natural history. On stating his observations on salmon spawning in the Tweed, he says—"On the 2nd of November, a pair of fish were watched, and the ova were observed to be deposited near the source of the river, and covered up in the usual way; and on the 25th of February, or 113 days after being deposited, the ova on being dug up were found unchanged; but three days later, or 116 days deposited, he says a very careless

observer could have seen the young fish turning over within the shell of the egg—(what a sudden change in three days!); but on the 23rd of March, the ova are now changing, the outer shell is cast, and the fry are lying embedded in the gravel, as fishes somewhat less than an inch in length,—being now twenty weeks from the period of their deposition." On the 22nd of April, when they were one month old, the all-wise Doctor says he was ca ching them with the fly as smolts, the size of his little finger.

We are not to doubt the Doctor's ability as an observer, neither do we think that he intended in the least to mislead the public, although, in the first place, he says the ova were much changed at 113 days; and, in the second place, he was catching the smolts one year old, believing them to be the fry of one month old. How could he be blamed for believing so? as at that time every one believed in the rapid growth from the egg to the smolt, as well as he, and no man then imagined that young salmon under the size of smolts existed in the rivers. All fishers, and those who observed the habits of fish, were aware that during the summer months the rivers swarmed with small fish, from one inch to three inches long, but what these fishes were none could form a satisfactory opinion; for if any one ventured to suppose that they might be the young of the salmon, he was soon told by others that no young salmon could be seen in the rivers later than the month of May, and confirmed it by repeating some old rhyme, such as—

"The first flood in May
Carries all the smolts away."

We are all aware that, in old times, old rhymes were much more relied on than new facts, and the old faith continued among fishers up to the time that repeated experiments convinced us that our belief was wrong; that in place of the fry that are hatched in

find one grain of the unimpregnated part productive, while the other portion that was impregnated with the milt never failed to produce fry in due time. This has been frequently tried, and has at all times proved the same.

The ova, after being deposited, progress very slowly, particularly during the winter season, when the temperature of the water is low; as the length of time between deposition and hatching depends entirely on the heat or cold when the seed is lying among the gravel. Ova deposited in September, when the temperature is high, will produce fry in the course of 90 days, while those deposited in November and December, will require something between 100 and 140 days, according as the winter months may be favourable or unfavourable. Until of late years, it was never imagined that seed spawned in September and October were hatched, and the fry at large in the rivers, in the following December and January. No. Our forefathers believed that both early and late spawn lay snug in the egg until the following spring, and then appeared at or near the same time, and in the course of a few days afterwards proceeded to the sea as smolts. This was the settled opinion of Naturalists and others, who have studied and written volumes on the habits of the salmon, and, among others, that celebrated Naturalist and dissector, Dr. Knox, who watched the spawning beds until he thought he had arrived at their habits and natural history. On stating his observations on salmon spawning in the Tweed, he says—"On the 2nd of November, a pair of fish were watched, and the ova were observed to be deposited near the source of the river, and covered up in the usual way; and on the 25th of February, or 113 days after being deposited, the ova on being dug up were found unchanged; but three days later, or 116 days deposited, he says a very careless

observer could have seen the young fish turning over within the shell of the egg—(what a sudden change in three days!); but on the 28rd of March, the ova are now changing, the outer shell is cast, and the fry are lying embedded in the gravel, as fishes somewhat less than an inch in length,—being now twenty weeks from the period of their deposition." On the 22nd of April, when they were one month old, the all-wise Doctor says he was ca ching them with the fly as smolts, the size of his little finger.

We are not to doubt the Doctor's ability as an observer, neither do we think that he intended in the least to mislead the public, although, in the first place, he says the ova were much changed at 113 days; and, in the second place, he was catching the smolts one year old, believing them to be the fry of one month old. How could he be blamed for believing so? as at that time every one believed in the rapid growth from the egg to the smolt, as well as he, and no man then imagined that young salmon under the size of smolts existed in the rivers. All fishers, and those who observed the habits of fish, were aware that during the summer months the rivers swarmed with small fish, from one inch to three inches long, but what these fishes were none could form a satisfactory opinion; for if any one ventured to suppose that they might be the young of the salmon, he was soon told by others that no young salmon could be seen in the rivers later than the month of May, and confirmed it by repeating some old rhyme, such as—

"The first flood in May
Carries all the smolts away."

We are all aware that, in old times, old rhymes were much more relied on than new facts, and the old faith continued among fishers up to the time that repeated experiments convinced us that our belief was wrong; that in place of the fry that are hatched in

find one grain of the unimpregnated part productive, while the other portion that was impregnated with the milt never failed to produce fry in due time. This has been frequently tried, and has at all times proved the same.

The ova, after being deposited, progress very slowly, particularly during the winter season, when the temperature of the water is low; as the length of time between deposition and hatching depends entirely on the heat or cold when the seed is lying among the gravel. Ova deposited in September, when the temperature is high, will produce fry in the course of 90 days, while those deposited in November and December, will require something between 100 and 140 days, according as the winter months may be favourable or unfavourable. Until of late years, it was never imagined that seed spawned in September and October were hatched, and the fry at large in the rivers, in the following December and January. No. Our forefathers believed that both early and late spawn lay snug in the egg until the following spring, and then appeared at or near the same time, and in the course of a few days afterwards proceeded to the sea as smolts. This was the settled opinion of Naturalists and others, who have studied and written volumes on the habits of the salmon, and, among others, that celebrated Naturalist and dissector, Dr. Knox, who watched the spawning beds until he thought he had arrived at their habits and natural history. On stating his observations on salmon spawning in the Tweed, he says—"On the 2nd of November, a pair of fish were watched, and the ova were observed to be deposited near the source of the river, and covered up in the usual way; and on the 25th of February, or 113 days after being deposited, the ova on being dug up were found unchanged; but three days later, or 116 days deposited, he says a very careless

observer could have seen the young fish turning over within the shell of the egg—(what a sudden change in three days!); but on the 28rd of March, the ova are now changing, the outer shell is cast, and the fry are lying embedded in the gravel, as fishes somewhat less than an inch in length,—being now twenty weeks from the period of their deposition." On the 22nd of April, when they were one month old, the all-wise Doctor says he was ca ching them with the fly as smolts, the size of his little finger.

We are not to doubt the Doctor's ability as an observer, neither do we think that he intended in the least to mislead the public, although, in the first place, he says the ova were much changed at 113 days; and, in the second place, he was catching the smolts one year old, believing them to be the fry of one month old. How could he be blamed for believing so? as at that time every one believed in the rapid growth from the egg to the smolt, as well as he, and no man then imagined that young salmon under the size of smolts existed in the rivers. All fishers, and those who observed the habits of fish, were aware that during the summer months the rivers swarmed with small fish, from one inch to three inches long, but what these fishes were none could form a satisfactory opinion; for if any one ventured to suppose that they might be the young of the salmon, he was soon told by others that no young salmon could be seen in the rivers later than the month of May, and confirmed it by repeating some old rhyme, such as—

"The first flood in May
Carries all the smolts away."

We are all aware that, in old times, old rhymes were much more relied on than new facts, and the old faith continued among fishers up to the time that repeated experiments convinced us that our belief was wrong; that in place of the fry that are hatched in

find one grain of the unimpregnated part productive, while the other portion that was impregnated with the milt never failed to produce fry in due time. This has been frequently tried, and has at all times proved the same.

The ova, after being deposited, progress very slowly, particularly during the winter season, when the temperature of the water is low; as the length of time between deposition and hatching depends entirely on the heat or cold when the seed is lying among the gravel. Ova deposited in September, when the temperature is high, will produce fry in the course of 90 days, while those deposited in November and December, will require something between 100 and 140 days, according as the winter months may be favourable or unfavourable. Until of late years, it was never imagined that seed spawned in September and October were hatched, and the fry at large in the rivers, in the following December and January. No. Our forefathers believed that both early and late spawn lay snug in the egg until the following spring, and then appeared at or near the same time, and in the course of a few days afterwards proceeded to the sea as smolts. This was the settled opinion of Naturalists and others, who have studied and written volumes on the habits of the salmon, and, among others, that celebrated Naturalist and dissector, Dr. Knox, who watched the spawning beds until he thought he had arrived at their habits and natural history. On stating his observations on salmon spawning in the Tweed, he says—"On the 2nd of November, a pair of fish were watched, and the ova were observed to be deposited near the source of the river, and covered up in the usual way; and on the 25th of February, or 113 days after being deposited, the ova on being dug up were found unchanged; but three days later, or 116 days deposited, he says a very careless

observer could have seen the young fish turning over within the shell of the egg—(what a sudden change in three days!); but on the 23rd of March, the ova are now changing, the outer shell is cast, and the fry are lying embedded in the gravel, as fishes somewhat less than an inch in length,—being now twenty weeks from the period of their deposition." On the 22nd of April, when they were one month old, the all-wise Doctor says he was ca ching them with the fly as smolts, the size of his little finger.

We are not to doubt the Doctor's ability as an observer, neither do we think that he intended in the least to mislead the public, although, in the first place, he says the ova were much changed at 113 days; and, in the second place, he was catching the smolts one year old, believing them to be the fry of one month old. How could he be blamed for believing so? as at that time every one believed in the rapid growth from the egg to the smolt, as well as he, and no man then imagined that young salmon under the size of smolts existed in the rivers. All fishers, and those who observed the habits of fish, were aware that during the summer months the rivers swarmed with small fish, from one inch to three inches long, but what these fishes were none could form a satisfactory opinion; for if any one ventured to suppose that they might be the young of the salmon, he was soon told by others that no young salmon could be seen in the rivers later than the month of May, and confirmed it by repeating some old rhyme, such as—

"The first flood in May
Carries all the smolts away."

We are all aware that, in old times, old rhymes were much more relied on than new facts, and the old faith continued among fishers up to the time that repeated experiments convinced us that our belief was wrong; that in place of the fry that are hatched in

find one grain of the unimpregnated part productive, while the other portion that was impregnated with the milt never failed to produce fry in due time. This has been frequently tried, and has at all times proved the same.

The ova, after being deposited, progress very slowly, particularly during the winter season, when the temperature of the water is low; as the length of time between deposition and hatching depends entirely on the heat or cold when the seed is lying among the gravel. Ova deposited in September, when the temperature is high, will produce fry in the course of 90 days, while those deposited in November and December, will require something between 100 and 140 days, according as the winter months may be favourable or unfavourable. Until of late years, it was never imagined that seed spawned in September and October were hatched, and the fry at large in the rivers, in the following December and January. No. Our forefathers believed that both early and late spawn lay snug in the egg until the following spring, and then appeared at or near the same time, and in the course of a few days afterwards proceeded to the sea as smolts. This was the settled opinion of Naturalists and others, who have studied and written volumes on the habits of the salmon, and, among others, that celebrated Naturalist and dissector, Dr. Knox, who watched the spawning beds until he thought he had arrived at their habits and natural history. On stating his observations on salmon spawning in the Tweed, he says—"On the 2nd of November, a pair of fish were watched, and the ova were observed to be deposited near the source of the river, and covered up in the usual way; and on the 25th of February, or 113 days after being deposited, the ova on being dug up were found unchanged; but three days later, or 116 days deposited, he says a very careless

observer could have seen the young fish turning over within the shell of the egg—(what a sudden change in three days!); but on the 23rd of March, the ova are now changing, the outer shell is cast, and the fry are lying embedded in the gravel, as fishes somewhat less than an inch in length,—being now twenty weeks from the period of their deposition." On the 22nd of April, when they were one month old, the all-wise Doctor says he was catching them with the fly as smolts, the size of his little finger.

We are not to doubt the Doctor's ability as an observer, neither do we think that he intended in the least to mislead the public, although, in the first place, he says the ova were much changed at 113 days; and, in the second place, he was catching the smolts one year old, believing them to be the fry of one month old. How could he be blamed for believing so? as at that time every one believed in the rapid growth from the egg to the smolt, as well as he, and no man then imagined that young salmon under the size of smolts existed in the rivers. All fishers, and those who observed the habits of fish, were aware that during the summer months the rivers swarmed with small fish, from one inch to three inches long, but what these fishes were none could form a satisfactory opinion; for if any one ventured to suppose that they might be the young of the salmon, he was soon told by others that no young salmon could be seen in the rivers later than the month of May, and confirmed it by repeating some old rhyme, such as—

"The first flood in May
Carries all the smolts away."

We are all aware that, in old times, old rhymes were much more relied on than new facts, and the old faith continued among fishers up to the time that repeated experiments convinced us that our belief was wrong; that in place of the fry that are hatched in

state of existence, and providing meat seems an amusement, as well as a duty; for we see them leaping for sport, as well as greedily catching the small objects among the water. After this, they improve in appearance very fast; for at the age of Two Months we have a perfectly formed fish—the transverse bars visible, and the fins distinct. From these transverse bars alone arose many of the arguments against them being the young of the salmon; for supposition said, that the fish with the transverse bars were pars, and that the young salmon were enveloped in the silver coating when they were hatched, and that they continued in that dress throughout all their after ages.

Until of late years, a full-formed salmon, of little more than an inch long, was never suspected to exist; for, by confounding the one year's produce with the other, they were supposed and asserted to be the size of a man's little finger, at the age of five days. The fry of Four Months old are about two inches long, and the transverse bars, commonly called the marks of the par, are very visible; the fins much larger than the fins of various trout of the same size, and, although but small in appearance, it plainly shows that they are the young of large fishes. They now feed greedily and briskly, so that any insect thrown into the pond is instantly seized by some one of the hundreds which strive to catch it first. It is wonderful how familiar they get at this age; for, being accustomed with daily feeding, they congregate together, and snatch up the particles as soon as they fall into the pond, and, unless by some rapid movement or other, they never seem to be disturbed.

At the age of Six Months they measure about three inches long, and thick in proportion,—the fins keeping still in advance, and the transverse bars perfectly distinct. From the age of Five weeks and upwards, few or no deaths occur among them, and they all

appear healthy and vigorous,—leaping and sporting freely among the waters, and seeming perfectly satisfied with their situation. From the age of Six to Ten Months their growth is very slow; the low temperature of the water during that time retards their growth materially, and affects their progress in the same proportion as it did the progress of the ova during the previous winter; for at the age of Ten Months we find them to measure only from three to three and a half inches, but both fish and bars appear more light in the colour. But at the age of Eleven Months the new scales and silver coating begin to appear, the transverse bars begin to look more dimly through the scaly coating, and we now see the young fish fairly entered into another wonderful and interesting change, which now advances rapidly towards perfection—by the scales spreading more and more over the fish, and the transverse bars gradually disappearing, until, at the end of Twelve Months, they are completely enveloped in the silver coating, and the bars of the fry have altogether disappeared;—but we may mention here, for the information of the few unbelievers, that by scraping off the scales of a smolt, the transverse bars will distinctly appear. They have now got on their migratory dress,—they are fully prepared to leave the stream of their nativity, for the trackless ocean,—they are now full of mirth and activity, gathering together in shoals, and sporting freely among the waters, feeding greedily, and, at this time, will very readily rise at and catch a fly, either natural or artificial. At this age many of them are destroyed by fly fishers, and even by small minnows with the pin and worm, and, therefore, they now require strict protection from the many idlers who plot their destruction, and who consider it the finest sport.

We have various accounts of their size at this age. Some make the smolts in general eight inches long; some have seen them ten

inches, while others have even ventured as high as fourteen inches long. We could mention numbers of half-and-between experiments, from which we have various accounts, and although we are convinced that these experiments were tried with the best intentions, yet they fell very far short of the truth; as they were often placed in ponds and places of confinement, and their ages, both when they were put in and taken out, unknown. From these imperfect experiments have arisen all the conflicting opinions regarding their size in the smolt state; for, among the whole congregation of smolts, their actual size varies from Four to Six inches in length—some being four and some six—but the great majority will be found to measure about Five inches.

The greatest throng of smolts descending the rivers is either in the months of April or May, thereby corresponding with the throng of spawning in November and December. In a very mild and favourable winter, we will have the throng in the following April; while in a severe and stormy winter, it will throw them back to May,—their whole proceedings being entirely dependent on the temperature of the water. These facts are seen by the most careless observer, although it was never imagined that the temperature of the water was the occasion of these variations: all that was said on the subject was, that "the smolts are early," or, "the smolts are late this season." But now, from repeated experiments and observations, we know perfectly well whether the smolts are to be late or early, long before they make their appearance in the smolt state; and we know as well, whether or not we are to have a good or a bad grilse fishing. The knowledge of these things were long looked for, but now the facts are completely established and regularly seen.

When we see the myriads of smolts descending the rivers, and

when we see the careless and thoughtless-like manner in which they sport among the waters, we are apt to imagine that, when they arrive in the boundless ocean, they will never more be seen or heard of in the rivers of their nativity. Yet they return! Yes, with the greatest punctuality they return to the streams in which they were bred. Nature has formed them with such wonderful instinct that none of them will pass their own home, nor will they be induced to call at a neighbouring habitation. We have ascertained all these things, and cleared them up, so that there is not a shadow of doubt left remaining. We have marked the smolts with various marks, and for a twofold purpose;—first, to ascertain if they actually returned to the same rivers, and, secondly, to ascertain how long they remained in the sea before they returned to the rivers. From these repeated experiments and observations, we have arrived at the facts of their actual habits. First, we marked the smolts by a perforation in the caudal fin. This was done by particular nipping irons, expressly made for the purpose, and the markings took place at different times, during the months of April and May. In the course of the months of June and July following, we caught them returning to the rivers, beautiful grilses, varying from Three to Eight pounds,—the difference being entirely regulated by the length of time they had remained in the sea,—and none of them being found but in the rivers where they were marked. Again, in the following months of April and May, we marked a number of the descending smolts, by cutting the odipase, or dead fin, clean off the back, and we found them returning to the rivers where they were marked, with the same punctuality as the others had done which had the perforated marks. Although it is unnecessary to particularize all the repeated markings and returnings, all of which tended to the same facts, we may mention

that specimens of these may be seen in the Royal Society's Museum in Edinburgh, with an exact account of their goings and returnings, all of which show the length of time they remain in the sea, as well as their punctuality in returning to the rivers where they were bred.

When the smolts are descending the rivers, they are always found congregated together and going in bands; and the grilses, when coming up from the sea to the rivers, have the same inclination to go together, but they are often scattered over the rivers by seals, porpoises, &c., which at that season are invariably to be seen lurking about the mouths of the rivers, watching for their arrival there. In flowing tides, grilses are very apt to run up the shallow sides, and over the space covered at high water, and from this cause the murderous, unlawful-looking instrument, called "a Stake Net," catches great numbers of them; and the destruction is not altogether from what they kill with these nets, but from the hundreds that, by their standing as a complete barrier, are turned back to the sea. It is well known that, during the months of June and July, salmon do not leave the tideway with the same determination that they do earlier or later in the season; therefore, any obstruction placed in their way during that time is the more injurious, and has been known almost to ruin rivers. For instance, we may look at the state of the river Tay, in 1812. When the Stake Nets were in full operation there, the rental for the whole river above Newburgh had fallen to the sum of £5,100; the Stake Nets were then removed by law, as being illegal obstructions to the fish in their progress to the river; and in 1819, or seven years after, the rental of the river rose to £14,627. Do these facts speak for themselves? Will they not induce proprietors of fishings to pause and consider, before it be too late, seeing the

ruin of the fisheries has already begun in many shapes, and, unless a thorough reform of the whole system takes place, the total ruin of them is inevitable?

On the first arrival of the grilses in the rivers they are but small in size, and long for their weight—some of them only a pound weight, and others under it; but as the season advances, we have a daily improvement, both in look and size, so that by the middle of July they will average five or six pounds' weight, and some of them during the season have been got from twelve to fourteen pounds. At this time they afford full employment to the fishers—those with the rod as well as those with the net,—and we have not unfrequently seen a new beginner find one of them heavy enough for his first fish, believing that he had at last the good fortune to hook and bring ashore a monster, although we have seen an experienced angler land and bag a dozen of them in one day.

The grilses that escape the many snares through the summer spawn the following season, and in that respect they follow Nature's laws, and not example; for we see them regularly on the spawning-fords before we see any salmon there, and they select the proper spot for the spawning-bed with wonderful correctness. Never is one seen to begin the operations in an unsuitable place; for they go through the whole course of their work with the utmost regularity, and, although a grilse spawn only about a third of the eggs that a salmon does, its spawn is equally sure and productive, and adds very materially to increase the breed.

We are told there are grilses that are the young of the salmon, and also grilses that always remain grilses; but we must confess that, among all the salmon and salmon-kind we have seen, we have never yet been able to discover one of the latter class, and we

have diligently searched for it, but in vain. We have marked hundreds of grilses, after their leaving the spawning-fords, by inserting copper wire rings into the fins. We repeated these experiments year after year, always marking them on a different fin, and among all those marked we have never been able to meet with one of them as a grilse, on their second return from the sea. The grilses, when marked, were as near to four pounds weight as we could select them; and, during the following spring and summer, we caught them, after their second return from the sea, all in the salmon state, and varying in weight from nine to fourteen pounds. On their return we examined them very minutely, endeavouring to find one among them that had returned as a grilse, but have at all times completely failed to do so; therefore, we are inclined to discard from the category altogether that class of grilses which always remain grilses, and disbelieve entirely in the existence of such a species.

We have also marked numbers of spawned salmon, both after their second and third spawning, and have found, at all times, that the length of their sojourn in the sea exactly corresponds with the length of time from the smolt to the grilse, and from the foul grilse to the salmon. The time from the smolts descending the rivers, until they return to the rivers as grilses, is about eight weeks; and from the time the spawned grilses leave the rivers, until their return as salmon, about eight weeks, and so on throughout all their after stages. We allude here only to the great body of the fish, as there may be numerous exceptions from this general rule, and part of them we have seen, and heard of others, viz.—some of them returning earlier than the time we have stated, and others remaining longer in the sea. The present George Augustus Frederick John Murray, Duke of Atholl, has taken a very deep

interest in endeavouring to find out the exact history and habits of the salmon; and to arrive with more certainty at these, he, with zinc tickets, marked all the spawned salmon he could catch. The tickets are numbered from one upwards, with Atholl on the reverse side, and his Grace keeps a register of the dates, No., and weight of all the fish so caught and marked, which show the exact time they remain in the sea, as well as the increase of weight during that time. Among many others, in March, 1845, in the river Tay, near Dunkeld, his Grace caught a spawned salmon, Ten Pounds weight, which he there marked with ticket No. 129,* and returned it to the river, and, of course, very soon afterwards it had gone down to the sea. In the short space of Five weeks

* The most interesting and remarkable example of this rapid increase of weight with which we are acquainted, is noted in the following extract from a private letter by his Grace the Duke of Atholl:

"I have received the ticket No. 129 from Mr. Wilson, and on referring to my salmon journal, I find that I caught this fish as a kelt this year, on the 31st of March, with the rod, about two miles above Dunkeld Bridge, at which time it weighed exactly ten pounds; so that in the short space of five weeks and two days, it had gained the almost incredible increase of eleven pounds and a quarter; for, when weighed here on its arrival, it was twenty-one pounds and a quarter.

"I assure you that I cannot too strongly express how much I am gratified by the interest you have taken in my experiments to ascertain the natural habits and growth of salmon. I only wish that all those connected with the fishing on the Tay would be induced to spare the kelts on their way down to the sea, for I fear much that most of those I marked last year were destroyed on their way down the river, and that it is owing to the favourable *spate* we had this year that this fish has been enabled to return as a salmon, and thus still further corroborate the statements made by Mr. Young in his very interesting pamphlet you were so kind as to send me, and for which I now beg to take the opportunity of thanking you.—I am, &c.

(Signed) "GLENLYON.

"Dunkeld, May 11, 1845."

and three days, the same salmon, with the ticket attached to it, was caught returning from the sea, on a fishing station at Pitfour, and, when caught, it weighed Twenty-one Pounds and a quarter—being an increase of Eleven Pounds and a quarter in the short space of five weeks and three days! This is among the earliest returns that we have seen; but we have seen stragglers at all times, between that and fourteen weeks—this being their longest absence from the river that we have at any time observed—and of these but very few; for the main body of the fish are perfectly regular, and remain in the sea only two months, during which time their growth is so rapid that, had it not been ascertained from undeniable experiments, the truth might yet have been doubtful. All incredulity must now be laid aside, when we see, in the course of two months, a small five-inch-long smolt grow into a beautiful grilse of Five or Six Pounds weight; a spawned grilse, of Four Pounds, grow into a salmon of Fourteen Pounds; and, in the space of Thirty-eight days, to see a foul salmon of Ten Pounds increase to a salmon of Twenty-one Pounds and a quarter. This rapid growth is entirely owing to the changing of their locality, which they do from the feeding ground to the breeding ground, and back again with wonderful exactness. They have their times and seasons, and, unless prevented from doing so, they observe these with the correctness of a sun-dial. Nothing can derange their habits but the injustice of man. Man rears bulwarks on their natural pathways, by which he deranges the order of nature in one of the most perfect and wonderful works of creation, and, were it not for the prolific nature of the race, they had long ere now been extinct.

It is essentially necessary that the salmon leave the rivers at certain seasons and go to the sea; for were they always to remain

in the rivers, we could never have clean salmon, and were they to remain always in the sea, they could not propagate their race. They require the fresh water streams for breeding, and they require the salt water seas for feeding, and without the use of these, at their seasons, the race would soon become inferior or extinct; and no trifling self-interest should induce us to prevent them from getting a full and proper seed time. Give them a regular, natural, plentiful, and proper seed time, and then we may reap a plentiful harvest without injuring the stock. We must say again, that the existing Laws, allowing fishing to the 14th of September, are ruinous in the extreme; *for fishing the Sea Coast as late as the 14th of September, is equal to fishing the Rivers to the 14th of October*, and in both cases the thing is perfectly absurd. All who really understand the true theory of salmon fishing, as well as all concerned in fisheries, are perfectly aware that, by fishing to either of these dates, the principal part of the breeders for that season are destroyed, and they are equally well aware that, from the same cause, the value of the fisheries is yearly diminishing; but yet they will not give over the work of destruction. No; they hold on, with a death-like grasp, destroying the already scanty remainder.

Mr Home Drummond's Act has cut off the winter fishing, which is now forbidden, and no fishing in Scotland is allowed to begin before the first of February. This is no great improvement. If the foul or spawned fish be spared, and the present Law "provides" for their safety, we can see no harm in early fishing; for, at that season, we would only kill a few clean and valuable salmon, which could not then add in the least to the stock of breeders,—at all events, they cannot do so until they first return to the sea. This has been proved to be an undoubted fact; for, from their lying eight or nine months in the river, they get so lean and their

generative organs become so contracted, that they must return to the sea before they can be productive. The assertion that salmon only ascend the rivers for the purpose of breeding is wrong; for salmon leave the sea and return to the rivers in which they were bred, and remain no longer in the sea than during their short feeding time,—the fresh water streams being always their home.

Were salmon to ascend the rivers only for the purpose of spawning, as is believed by some, we could never in these rivers have first-rate salmon; for they would never come up until they were fully prepared for the spawning-bed, and our best salmon would be nothing better than the inferior fish that are killed in September. Such is not the case; for the salmon come to the rivers as soon as they are fat enough, and, except at the end of the season, they never remain in the sea until they are bagged with spawn. All these things are only false suppositions, or statements, to serve a purpose; but, we must say, that the principal and most rational way, as well as the most profitable, is to kill the clean and valuable fish in the early part of the season, and save the foul, bagged, and useless part at the latter end of the season, the more particularly as the early fish do not, in that season, add to the stock of breeders, while the late fish invariably do so. We will again say, why not encourage and increase the breed of such a valuable fish?

It may not be out of place to mention here, that we have always observed, when we have a succession of high "spates" in the Spring, produced entirely from melted snow, that the fish are very backward in entering rivers; the snow water, in the first place, drives what fish are in the firth back to the sea, whence they will not attempt to return until the temperature of the water rises. There is one very curious fact which we have always observed to be a never failing case, that is, their knowledge of

coming storms, and changes of the weather. During a run of good weather and fair fishing, the fish are certain to stop running a day or two before a storm, or any visible appearance of a change of weather takes place; and during the storm, or when at its worst, if we find the fish on the move forward, we are quite certain that a break of the storm is near. We have often told our friends and men when we were to have a change of weather, which never failed to be the case; and our information was got entirely from the "Water Thermometer," which is more certain than the mercury in the common tube.

Salmon, like other stocks, require herding and waiting on; and although their pastures require no improvement from the hand of man, still they require to be protected while on these pastures—particularly in rivers and firths. A sufficient River Police is absolutely necessary to be kept up, and for that the law provides. These should be a carefully selected band, and, in their selection, friends, favourites, "hangers on by the tail," and such godsake labourers, should be carefully avoided. They should be selected from among the most active and persevering of the fishermen, whom we never fail to see having an interest in the welfare of the fish; whereas any other force just watch for their wages, if they watch at all, as most commonly they do not.

It is also necessary to destroy, as much as possible, the natural enemies of the salmon. Among the most destructive of these, we would mention the water-ouzel and river-trout, both of which vermin haunt the fords in spawning time, and commit great depredations among the new spawned seed. The water-ouzel is a small black bird, which watches the spawning operations with the cunning of a fox, and, as soon as a portion of the spawn is deposited, it darts into the spawning-bed, and never fails to secure to itself a

portion of the seed. It continues thus during all the spawning season, and, in the course of that time, it devours immense quantities of seed; for we will at no time, during that season, find one of them but what is literally crammed with the seed. The proper and only method for the destruction of these, is to shoot them on the ford, which at that season is not at all difficult to do; for they are invariably to be seen sitting on some stone near to the spawning-bed, and wherever they are seen, it is a certain sign that spawning fish are near. Also, by allowing the river-watchers to carry guns, and by giving them a small premium for each ouzel produced, they might very soon be destroyed.

The river-trout may, among all others, be considered the salmon's greatest enemy; for myriads of them haunt the fords the whole of the spawning season, and wherever we see a spawning-bed, dozens of trout are to be seen watching with the greatest eagerness to pick up the spawn, which, from its well known peculiar attraction, gathers them from all the pools in the river. The salmon are often seen hunting them away from the spawning-bed, but no sooner do they commence their spawning operations, than multitudes of these trouts return and hover round the beds, watching the time when a portion of the seed is deposited, when they never fail, demon-like, to dart into the bed and devour a portion of it. This they continue to do throughout all the spawning season, and, from their well known gormandizing nature, devour immense quantities of the seed. We have often, during the spawning season, caught these vermin on the fords; for, being always anxious to arrive at something near the amount of their destruction, we had no other means of doing so. When we dissected those that we caught, we found them literally crammed with the salmon spawn; and from one trout, under two pounds weight,

we extracted upwards of Eighty Grains of seed. These are specimens and certain proofs of the destruction done by the river-trout during the spawning season; and when the amount of their destruction is so well known, every practical endeavour should be used to clear them away from salmon rivers.

It is not only during the spawning season that trout are destructive to the salmon, but as soon as the fry are hatched and abroad in the rivers, they actually feed upon them, and continue to do so during the first twelve months of their existence. We once put a dozen of smolts into a pond, along with a trout of half a pound weight, and by next day the Gorgon had devoured the whole twelve; and we have not the least doubt, but that the trout at large in the river have an equal share daily, with the one with which we tried the experiment. It is, therefore, essentially necessary that these voracious enemies should be destroyed in salmon rivers, or, at all events, be reduced to the fewest possible number; and, among the many practical methods of doing so, we would strongly recommend—

Catching them with the net at certain seasons,

And carefully nursing and preserving the Otter, as an effectual means of destroying the large river-trouts.

The trout can be most successfully caught at the end of the spawning season. As soon as salmon disappear from the fords, that is the time to begin; for then they will be found congregated together in the first pool below the spawning-ford, and there, with a net made for the purpose, they can be caught in great numbers. By continuing occasionally to fish these pools, they can be very much reduced; for, with one haul of the net, we have seen taken from one of these pools upwards of Seven Hundred trout. They can also be successfully caught in these pools immediately

preceding the spawning time, where they have arrived to watch when the spawning operations begin. But this time is not quite so available as at the latter end of the season; for, at the first of it, we are likely to disturb some of the salmon who are there waiting till nature informs them when to begin the work of generation, and where disturbing them might retard their progress.

The Otter is a most wonderful and useful creature in a salmon river, and yet its usefulness is but little known. It has long been represented as one of the salmons' worst enemies, while in truth it is one of their best friends. It is true that the otter will, at very rare times, hunt and kill a salmon; but this only happens in cases of severe necessity—only at times when frosts or other natural causes have debarred it from the lake or the trout pond. Indeed, it is very seldom that the otter will catch a salmon by fair hunting; for when hunger forces him on to the uncertain attempt, it is done more from cunning than from speed. He entices the salmon into some small or shallow corner, where escape is impossible, and there gets hold of it. But the only attempt to do so is when his easier managed neighbour, the trout, is not to be got at all; for when the rivers are open, and trout numerous, the otter has full sport, as he often hunts and kills more for amusement than for food, and he kills hundreds throughout the season that he leaves whole on the banks of the river, not even taking out the "otter's bite." We have, in the space of half an hour, seen him lay a dozen of trout on the bank of one pool; he seemed, tiger-like, to spring on them, and catch them by stealth, rather than by fair hunting; and, on the whole, otter fishing seems to be a nice amusement, and, therefore, his value in a salmon river must be very great. We would, therefore, recommend their strict protection, and not, as has been done formerly, almost drive them from

the face of the earth. Save the otter, but destroy water-ouzels and river-trout; and, in due season, save the salmon from the hands of inconsiderate man, their greatest and most deadly enemy.

We have now endeavoured to go over the changes and migrations of the salmon;—we have described the spawning and the breeding localities;—we have given a description of the ovum, from the time of deposition to the moment of hatching, how it is transferrable from one river to another, with the most certain reliance on success, and how barren rivers can be made productive;—we have described the state and appearance of the fry, from the time they are hatched, to the smolt state; we have, from undoubted experiments, traced the smolt to the sea, and back again to the river as a grilse; have followed the grilse to the spawning-bed, from that to the sea, and back to the river for the second time, as a salmon; also again to the spawning-bed, and from that to the sea, with an account of their various increase during these periods;—and all along we have endeavoured to point out the many obstacles in the way of improvement, all of which we can state as certain facts. We will now conclude, hoping that no self-interest—no ill-advised monopoly—nor any narrow-minded prejudices, will keep us from taking advantage of the improvements pointed out. Let the salmon have but fair play, and it will do essential service to the nation, as well as to those who own the fisheries. Let it never be forgotten that salmon is a most wholesome and nutritious food for man; and, like other fish, his keep costs nothing to the state nor to proprietors, so that, were it possible to provide that all smolts should become salmon ere they were taken for sale, a vast quantity of most excellent food would be added to the stock of the nation, without any cost whatever. If this cannot be, surely the present open and

close seasons should be more judiciously arranged, and so altered as better to preserve the breeding fish. It is believed that almost all well informed men agree on this, and yet nothing of late years has been done to remedy the existing evil.

APPENDIX.

The pairing of salmon (says the NORTH BRITISH REVIEW for May, 1848), during spawning time has been often observed; and it is a habit which we may reasonably infer would not prevail at that particular period, if it had taken place, according to Mr. Stoddart's hypothesis, after the spawning of the preceding year, when the fish were kelts. Mr. Andrew Young, the skilful and long-experienced manager of the Duke of Sutherland's North-country fisheries, in an unpublished letter now before us, writes as follows:

"Mr. Shaw is perfectly right in stating that salmon pair. I daresay I may say that I have seen more salmon spawning than any man alive at this time; and I am sure that I have never yet seen a female spawning without a male. But the services of one male are as good as those of another, if the milt of both is equally mature. A male fish, however, must be had, else the female will not remain a moment on the spawning ground. The experiment has been tried frequently (and is a well-known, though most reprehensible poaching practice,) by killing the male from the side of the female, and her first proceeding was to fall back into the pool below the spawning-ford, and from thence return with another male fish. This practical experiment has even been carried the length of picking off nine males successively from the side of the same individual female, and frequently have from three to eight been killed in that insidious manner. The fact is certain, that in the process of spawning, the female fish will be unproductive unless the ova come in contact with the milt, and that contact must occur when both milt and roe are in a state of maturity. Of this there need be no doubt. Deposit the ova without impregnation at the time of exclusion, and treat them otherwise as carefully as you can, and nothing is pro-

duced: impregnate the ova, and in due course you have a swarm of salmon-fry. Or take the milt and ova from a pair of salmon in August, when neither is as yet mature, and deposit them with equal care, you produce nothing: take the same materials from a brace of fish at a later period during the natural and spawning time, and when the fish are themselves upon the fords, and you produce fry. Mr. T. T. Stoddart draws far-fetched inferences from barn-door cocks and hens. He ought to recollect, that whether he disbelieves all natural facts or no, he himself writes on fishes."

In another communication (says the "North British Review") with which we have been favoured by Mr. Young, he adds as follows:—

"Mr. Shaw is quite correct in the principle on which he conducted his experiments on the hatching of salmon. Mr. T. T. S. admits that fishermen have seen (we wonder he has not done so himself!) the ova flowing from the female. So have I often, and also the milt from the male. Pray, of what use is the large quantity of the latter, found in salmon when they commence to spawn? Has nature formed that one thing in vain! Take a salmon from off the spawning ground in time of spawning, and hang it up by the head, and the milt will run off freely. The ova of the female fish will do the same. Mr. Tod Stoddart's work, so far as points of that kind are concerned, I assure you, is entirely against nature."

Our other MS. collections, which on this subject are curious and extensive, all confirm these views.

FINIS.